tainly have left at least some blocks of trap on the surface and no trap blocks are known to occur anywhere within seven miles of the fault.

11. He considers the fault to have "been caused by the pressure from below of the molten trap," and in support says that near Taylorsville he has "observed the dip of the red shales changed in the vicinity of a trap dike," a whole quadrant in direction. A more thorough investigation, however, has shown that the trap there is undoubtedly an overflow sheet conformable to the shales, and not a dike that has changed the dip of the shales. He also says that "near Harleysville a dike below the surface has metamorphosed the strata into black argillite and reversed the dip to the south." It is now known that Harleysville is near the axis of an important basin, or synclinal, somewhat closely though not steeply folded, and is on the belt of Perkasie Shales, that contain some dark and blackish beds, as well as many greenish ones, through a great length of outcrop, often several miles from any trap, and with no reason whatever to suppose the dark color to come from dikes below the surface instead of from the character of the original constituents of the shales, or to suppose the dips occasioned by the trap.

12. It is clear, then, that the Yardley fault is simply a transverse or normal fault, quite unconnected with any trap dike; that the fault dips eastwardly; that the downthrow is no doubt in the same easterly direction; that notwithstanding the conspicuousness of the fault through the contrasted colors of the rock beds, the amount of downthrow is probably no more than about a dozen feet; and that the extent of the fault along its strike is consequently not very great. As the fault is nearly at right angles with the strike of the rock beds, it would give, even if large, no great support to the old idea that the apparent thickness of the New Red might be due to a series of great faults parallel to the strike—an idea that has made the least appearance of an important fault in the New Red seem highly welcome to geologists. Such longitudinal faults are indeed generally of greater extent than transverse ones; but, as they can arise only from tremendous pressure on beds of great firmness, it is hard to imagine their occurrence in a region of such gentle dips and weak shaly beds as our New Red field.

The Chalfont Fault Rock, So Called.

By Benjamin Smith Lyman.

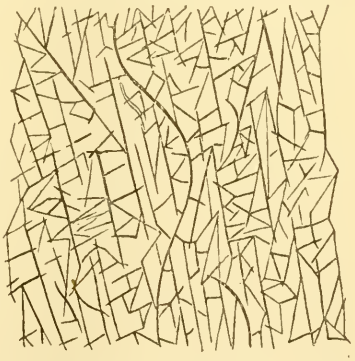
(*Read before the American Philosophical Society, September 6, 1895.*)

1. Situation.
2. Prof. Lewis's Description Cited.
3. The Two Photographs.
4. Southwesterly Dips in the Eastern Photograph.
5. Southwesterly Dips in the Western Photograph.
6. Southwesterly Dips Confirmed.
7. Saddle and Basin.
8. Conclusions.

1. Just east of the railroad station at Chalfont, in Bucks county, Penn-

sylvania, a deep rock cutting begins and extends two or three hundred yards eastward. It is the spot that the enthusiastic geologist and amiable gentleman, Prof. Henry Carvill Lewis, not long before he was so lamentably cut off in his early prime, particularly mentioned in his account of the immense fault that he supposed to affect the "great trap dike across southeastern Pennsylvania," described in his paper read before our Society on May 13, 1885, and published in our PROCEEDINGS, Vol. xxii, pp. 438–456.

2. He says (p. 449): "The line of fault is marked by abnormal dips, blackened and broken shales, 'slickensides,' and other evidences of violent disturbance, along its whole length. But its most characteristic feature is the occurrence of a zone of typical *fault rock*. This very interesting feature is composed of a mass of gray, shaly argillite, so crushed and cracked in every direction, and so baked and changed in character, that it has lost all traces of stratification. This peculiar rock, evidently the result of movement at the time of faulting, is cut by innumerable cleavage planes, crossing one another at every conceivable angle. The small and irregular angular blocks thus produced are very generally covered by slickensides, the result of sliding motion. This *fault rock* marks the line of fault, when all other indications fail, and has rendered it possible to fix the precise position of the fault from end to end. It fills a zone one hundred feet or more in width. The writer is not aware that such an extensive exposure of a fault rock has been previously described. A few yards is usually given as the greatest width to which a fault rock attains, although similar instances will doubtless be found elsewhere. The great development of this interesting formation along the Bucks County fault, leads to the conclusion that the process of faulting was a sudden event. The immense pressure which gave rise to the fault would appear to have been relieved by violent crushing and slipping, perhaps accompanied by earthquakes.



"The best exposure of this fault rock is in the railroad cut immediately east of Chalfont Station, on the Doylestown Branch of the Philadelphia and Reading Railroad —a locality which will well repay a visit. The accompanying sketch very rudely represents the appearance of the fault rock at this place."

3. The geological structure can be more accurately understood by the help of the two new photographs here reproduced, showing a large and the more difficultly interpreted part of the north side of the cut. They were most obligingly taken, with his accustomed skill and excellent

judgment, by Mr. E. B. Harden, formerly of the State Geological Survey, Assistant Geologist and Topographer and in charge of the Headquarters, Office and of Illustrations for the Reports. While Prof. Lewis's sketch gives the confused appearance of the numerous cleavage planes as looked at in a direction at right angles with the railroad, the photographs are views in line with the northwesterly strike of the rocks, and show more or less distinctly the dips and the bedding. For the rocks are clearly in fact not confusedly broken fault rock, but simply dark gray and dark red hard shales that are folded in basins and saddles with somewhat steep dips (fifty to seventy degrees); such shales as occur extensively through Bucks and Montgomery counties, and notably near the Gwynedd and Phœnixville tunnels, as well as here and there along the banks of the Neshaminy for a dozen miles below Chalfont.

4. The right-hand edge of the eastern photograph (Plate xi), taken at about one hundred and twenty-five yards east of the bridge over the western end of the cut and about five yards south of the centre of the railroad, shows very distinctly a dip of about fifty degrees southwesterly (south about sixty-three degrees west, true meridian). About the middle ground of the view, against the tall post with a slender horizontal pole as a signal of danger from the bridge to brakemen standing on freight cars, the edges of the rock beds are to be seen with a southwesterly dip of about seventy degrees, that continues almost uniform westward and is sixty-five degrees, south about forty-eight degrees west, near the western end of the cut, towards the bridge. That dip is also indicated in the more distant parts of the picture by the course of the small hollows and gullies that descend from the top of the cutting.

5. These western dips are more distinctly seen, on a larger scale, in the second photograph (Plate xii), taken at about twenty-six yards east of the bridge and about eight feet south of the centre of the railroad, looking in the same northwesterly direction along the strike. The layer, for example, some fifteen inches thick, that comes to the level of the railroad in the picture directly below the foot of the telegraph pole shows the dip unmistakably. Another layer about two feet to the east of that one is also pretty clearly distinguished in the picture; and the edge of another parallel layer is to be seen about two inches, in the picture, to the west of the first-mentioned layer. Besides that, the parallel edges of several less striking layers, that can be perceived even in the photograph, corroborate what is still more unquestionable on the ground, the uniform southwesterly dip throughout the field of the western photograph. Prof. Lewis's sketch apparently covered a portion of this field.

6. The steep southwesterly dips, then, are plain through most of the space covered by the two photographs. On the ground, they are moreover confirmed by the correspondence of small hollows occasioned by softer layers on the two sides of the railroad, as readily observed by Mr. Harden. The dips are still more easily recognized on the ground for some distance east of the eastern photograph. Likewise, about fifty feet

north of the western end of the railroad station (and the station is so close beyond the bridge that a small corner of the platform can be seen in the picture, beyond the right-hand abutment) an artificial rock exposure begins and extends nearly fifty yards westward, with unmistakable dips of forty degrees, south about fifty-three degrees west.

7. In the space, however, between the danger-post and the strongly marked dips of the eastern half of the eastern view, the structure is not so uniform, and is not so clearly shown by the photograph, nor indeed so easily made out on the ground. Ten yards along the cutting east of the danger-post and opposite the eastern end of a small stable on the top of the south side of the cut, and in the picture a little to the left or directly beneath the right-hand telegraph pole, in the rather smoothly rounded projecting rock mass, there is a small rock saddle, or anticlinal, that can be seen on the ground with some care, and can even be perceived in the photograph, especially where the layers about the midheight of the cut begin to bend over from the westerly dip. Six yards further east, on the western side of the first small depression or slight gully, and five yards west of the first strongly marked southwesterly dip surface, and in the picture almost directly below the telegraph pole, there is a small rock basin or synclinal, somewhat difficultly discerned in the photograph, yet still decidedly perceptible there with a little patience, particularly with the help of a strong magnifying glass, and quite visible on the ground. The partly obscure portion of the section, then, is at most a dozen or fifteen yards of the length of the cutting; and at right angles with the strike not more than eight or ten yards; and, as the photograph shows, it is apparently not the part represented by Prof. Lewis's sketch. It appears unfortunately impossible to make the dips of that portion extremely obvious in a photograph; but on the ground they can be seen with a little care, and have been distinctly recognized, not only by myself, but by Mr. Harden, and, in December, 1888, by Dr. Amos P. Brown and Mr. J. S. Elverson. The place is now so precisely pointed out that it can readily be identified by any one visiting the spot, and he can see for himself the accuracy of the description of the structure.

8. It is evident, then, that the rocks of the cutting are by no means fault rock, but merely steep-dipping and somewhat folded dark gray and dark red beds of the Gwynedd Shales, cut across at a sharp angle with the strike and much fractured with ordinary cleavage planes of many directions, and requiring for a perception of the structure to be observed at an angle of not more than forty-five degrees with the railroad instead of at right angles. The chief geological interest and value of the rock exposure, therefore, is not in its displaying a fault of otherwise incredible dimensions, with the unheard-of width of a hundred feet or more, and with the inconceivable heave of four or five miles for a nearly vertical trap dike; but in its showing how it may sometimes be a little difficult to distinguish the true bedding and dip among many confusing cleavage planes. The great fault, coming westward from the southern

edge of the island-like patch of paleozoic rocks near Doylestown, in fact does not go through the Chalfont cut at all; but nevertheless probably passes within a hundred yards north of it, as is shown by neighboring rock exposures on the other side of the fault and by changes in the color and character of the soil. There is no reason to suppose that the fault, great as it is, heaves in the least the trap dike that does probably exist pretty close north of it; and the trap that occurs within two miles and a half south of the fault at four or five miles to the east must undoubtedly belong to quite a separate dike. Instead of one great dike there seem to be several smaller ones not continuous nor quite in line.

On Apatela.

By A. Radcliffe Grote, A.M.

(*Read before the American Philosophical Society, October 18, 1895*).

The genus Apatela has awakened considerable interest on account of the diversity of types among the larvæ of the different species. As will be seen from my lists of the N. American species, these greatly exceed in number the European, and probably afford a larger number of these larval types; while nearly all of the European groups are represented in North America, the Agrotid fauna of the two continents being, as often insisted upon by me, closely related. It follows that our nomenclature is derived chiefly from European sources. It may be said that the Apatelidæ are difficult to distinguish from the Arctiidæ, by exclusive characters drawn from the imago.

I have only quite recently become acquainted with the extremely beautiful work of Dr. T. A. Chapman, on the genus Acronycta (Apatela) and its allies, London, 1893, a publication which at once placed its author among the foremost of the students of the new Lepidopterology, a school which has entirely broken with the old system under which the study had become sterilized, and was in danger of passing entirely into the hands of fanciers and dealers, at least in Europe. The results of the New School may be estimated by the statement, that the spectres of the metaphysical groups "Bombycidæ," "Zygænidæ," "Noctuidæ," "Tineidæ," which, especially the former, haunted our nomenclature, have been effectually exorcised. The "Bombycidæ" have been shown to be composed of families belonging to no less than three superfamilies: Bombycides, Agrotides, Tineides; the results attained through phylogenetic and ontogenetic studies are now applied to classification.

In my list published in these *Proceedings* in 1883, I had separated the three families of which the "Noctuidæ" were then composed, and this classification is the basis of the catalogue published as Bulletin No. 44, of the National Museum, Washington, 1893. Recent studies of Mr. Harrison